

REMARKS

In the last Office Action, the Examiner provisionally rejected claims 1-9 on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-12 of copending Application No. 10/672,946. Claims 1, 2 and 5-10 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,338,808 to Kawata in view of U.S. Patent No. 6,015,914 to Sasaki. Claim 3 was rejected under 35 U.S.C. §103(a) as being unpatentable over Kawata in view of Sasaki and further in view of U.S. Patent No. 5,296,528 to Lutjens. Additional art was cited of interest.

In accordance with the present response, independent claim 1 has been amended to further patentably distinguish from the teachings of the cited references by limiting the claim to a liquid crystal film obtained by fixing an aligned structure of a liquid crystal material containing at least a side chain-type liquid crystalline "copolymer". As discussed in detail below, no corresponding liquid crystal film is disclosed or suggested by the prior art of record.

To overcome the obviousness-type double patenting rejection, the owner presents herewith a terminal disclaimer together with the required disclaimer fee. The terminal disclaimer disclaims the terminal part of any patent granted on this application which would extend beyond the expiration date of any patent granted on commonly owned Application No. 10/672,946.

Applicants request reconsideration of their application in light of the foregoing amendment to claim 1, the terminal disclaimer, and the following discussion.

Brief Summary of the Invention

The present invention is directed to a liquid crystal film and to a liquid crystal display device having the liquid crystal film.

The specification (pages 1-4) discloses conventional liquid crystal films for liquid crystal display devices. As described in the specification, one type of conventional liquid crystal film is produced by forming a thin film of a polymeric liquid crystalline substance over a substrate with alignability and then heating the film to a temperature equal to or higher than the glass transition temperature ("Tg") so as to align the liquid crystal molecules, followed by quenching of the film to fix the aligned liquid crystal molecules.

However, although the foregoing method is applicable to both main chain- and side-chain type polymeric liquid crystalline substances, it suffers from the problem that available alignment substrates are limited because the temperature at which liquid crystallinity is exhibited rises when using a main chain-type polymeric liquid crystalline substance with a high Tg. Furthermore, when using a side chain-type polymeric liquid crystalline substance, the heat resistance of the resulting liquid crystal film is inferior

and the orientation of the corresponding liquid crystals becomes disordered at a temperature in the vicinity of the T_g .

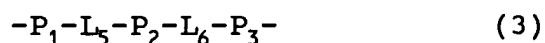
It has been proposed to resolve the foregoing and other problems with conventional liquid crystal films by providing a liquid crystal film in which a reacted group is directly introduced into a polymeric liquid crystalline substance with a relatively low T_g , such as a side chain-type one, and then cross-linked with an external stimulus such as light or heat after aligning the reactive group in a liquid crystal state, thereby raising the T_g . However, a problem with the foregoing liquid crystal film is that it has been difficult to synthesize such a side chain-type polymeric liquid crystalline substance with a reactive group. For example, when the polymeric substrate is constructed prior to the introduction of a reactive group, the amount thereof is prone to be insufficient. On the other hand, when a side chain-type polymeric liquid crystalline substance having a reactive group is synthesized from a monomer having two reactive groups by polymerizing one of the reactive groups, it becomes necessary to maintain the reactivity of the other reactive group lower than that of the reactive group to be reacted, leading to a problem that the reaction of the reactive group after aligning the reaction group in a liquid crystal state becomes insufficient.

The present invention overcomes the drawbacks of the conventional art by providing a liquid crystal film having excellent heat resistance and produced by fixing an aligned

structure of a liquid crystal material containing a side chain-type polymeric liquid crystalline substance obtained by polymerizing a novel compound having reactive groups with excellent reactivity for fixing the aligned liquid crystal structure and a difunctional low molecular weight liquid crystalline substance having two or more such reactive groups.

Figs. 1-10 disclose an example of a liquid crystal film (e.g., denoted by reference numerals 11 and 12 in Figs. 9-10) embodied in independent claim 1. The liquid crystal film according to the present invention is obtained by fixing an aligned structure of a liquid crystal material containing at least a side chain-type polymeric liquid crystalline substance obtained by copolymerizing the (meth)acrylic portion of a (meth)acrylic compound having an oxetanyl group represented by formula (1), shown on page 5 of the specification, with another (meth)acrylic compound and a difunctional low molecular weight liquid crystalline substance having two oxetanyl groups represented by formula (2), shown in page 6 of the specification.

In the foregoing formulas (1) and (2), R_1 is hydrogen or methyl; R_2 , R_3 , and R_4 are each independently selected from the group consisting of hydrogen, methyl, and ethyl; L_1 , L_2 , L_3 , and L_4 are each independently selected from the group consisting of a single bond, -O-, -O-CO-, and -CO-O-; M_1 and M_2 are each independently represented by a formula selected from the group consisting of formulas (3), (4) and (5) below; and l , m , n , and o are each independently an integer from 0 to 10:



In formulas (3)-(5), P_1 and P_2 are each independently a group selected from the group consisting of formulas (6) shown on page 7 of the specification; P_3 is a group selected from the group consisting of formulas (7) shown on page 7 of the specification; and L_5 and L_6 are each independently selected from the group consisting of a single bond, $-\text{CH}=\text{CH}-$, $-\text{C}\equiv\text{C}-$, $-\text{O}-$, $-\text{O}-\text{CO}-$ and $-\text{CO}-\text{O}-$.

By the foregoing construction, the present invention embodied in amended independent claim 1 provides a liquid crystal film having excellent heat resistance and reactivity. This is accomplished by fixing an aligned structure of a liquid crystal material containing a side chain-type polymeric liquid crystalline substance obtained by copolymerizing an oxetanyl group-containing a (meth)acrylic compound with a specific chemical structure as represented by the foregoing formula (1) and a low molecular weight liquid crystalline substance having two oxetanyl groups as represented by the foregoing formula (2). No corresponding structural combination is disclosed or suggested by the prior art of record.

Traversal of Prior Art Rejections

Claims 1-2 and 5-10 were rejected under 35 U.S.C. §103(a) as being unpatentable over Kawata in view of Sasaki. Applicants respectfully traverse this rejection and submit that the combined teachings of Kawata and Sasaki do not disclose or suggest the subject matter recited in amended independent claim 1 and corresponding dependent claims 2 and 5-10.

Amended independent claim 1 recites, inter alia, a liquid crystal film obtained by fixing an aligned structure of a liquid crystal material containing at least a side chain-type polymeric liquid crystalline substance obtained by copolymerizing the (meth)acrylic portion of a (meth)acrylic compound having an oxetanyl group represented by formula (1) (shown on page 5 of the specification) with another (meth)acrylic compound and a difunctional low molecular weight liquid crystalline substance having two ocetanyl groups represented by formula (2) (shown on page 6 of the specification).

Thus independent claim 1, as amended, is limited to a liquid crystal film obtained by fixing an aligned structure of a liquid crystal material containing at least a side chain-type liquid crystalline copolymer. As recognized by the Examiner, no corresponding liquid crystal film is disclosed or suggested by the prior art of record.

The primary reference to Kawata discloses a liquid crystal film obtained by fixing an aligned structure of a

liquid crystal material obtained by homopolymerizing the (meth)acrylic portion (col. 34, lines 55-56) of a (meth)acrylic compound represented by formula N33 (col. 30). Thus Kawata does not disclose or suggest a liquid crystal film obtained by fixing an aligned structure of a liquid crystal material containing at least a side chain-type liquid crystalline copolymer. In Kawata, the N33 compound has no oxetanyl group. Moreover, Kawata does not disclose or suggest a dioxetane compound, which is an essential component of the liquid crystal film recited in amended independent claim 1.

The secondary reference to Sasaki discloses a specific compound having an oxetanyl group. Sasaki discloses a synthesis of such a specific compound having an oxetanyl group using an oxetane compound with an oxiranyl group bound thereto and whose high reactivity is utilized for the synthesis (see column 3, lines 10-14). It is thus apparent that Sasaki does not use the oxiranyl group as a polymerizable group. In contrast, Kawata discloses an oxiranyl group (formula Q8) as one example of a polymerizable group. Furthermore, unlike Kawata, Sasaki does not deal at all with liquid crystals. Instead, Sasaki discloses that the compounds are used in the fields of coating wood and metals.

Thus, Kawata and Sasaki use the oxiranyl group for completely different purposes. Accordingly, contrary to the Examiner's contention, one of ordinary skill in the art would not have been motivated to use an oxetanyl group as taught by Sasaki in the liquid crystal compound used to form the liquid crystal film of Kawata.

Moreover, even if proper, the proposed combination of Kawata and Sasaki would not lead to the claimed invention because neither reference discloses or suggests the dioxetane compound required by amended independent claim 1.

Thus one of ordinary skill in the art would not have been led to modify Kawata in view of Sasaki in the manner proposed by the Examiner in the statement of rejection. The only basis for the modifications urged by the Examiner in the rejection is applicants' own disclosure, and such hindsight rejections are improper. See, for example, Diversitech Corp. v. Century Steps, Inc., 7 USPQ2d 1315, 1318 (Fed. Cir. 1988); In re Geiger, 2 USPQ2d 1276, 1278 (Fed. Cir. 1987); Panduit Corp. v. Dennison Manufacturing Co., 227 USPQ 337, 343 (Fed. Cir. 1985); Interconnect Planning Corp. v. Feil, 227 USPQ 543, 551 (Fed. Cir. 1985).

Claims 2 and 5-10 depend on and contain all of the limitations of amended independent claim 1 and, therefore, distinguish from the references to Kawata and Sasaki at least in the same manner as amended independent claim 1.

In view of the foregoing, applicants respectfully request that the rejection of claims 1, and 5-10 under 35 U.S.C. §103(a) as being unpatentable over Kawata in view of Sasaki be withdrawn.

Claim 3 was rejected under 35 U.S.C. §103(a) as being unpatentable over Kawata in view of Sasaki and further in view of Lutjens. Applicants respectfully traverse this rejection and submit that the combined teachings of Kawata,

Sasaki and Lutjens do not disclose or suggest the subject matter recited in claim 3.

Claim 3 depends on and contains all of the limitations of amended independent claim 1 and, therefore, distinguishes from the references at least in the same manner as claim 1.

Furthermore, the secondary reference to Lutjens relates to a transparent thermoplastic molding composition containing a polycarbonate and an oxetanyl alkyl(meth)acrylate polymer. Thus, Lutjens does not relate at all to the field of liquid crystals, as do claim 3 and the primary reference to Kawata. Accordingly, contrary to the Examiner's contention, one of ordinary skill in the art would not have found it obvious at the time the invention was made to employ in Kawata, as modified by Sasaki, the weight-average molecular weight within the range taught by Lutjens.

In view of the foregoing, applicants respectfully request that the rejection of claim 3 under 35 U.S.C. §103(a) as being unpatentable over Kawata in view of Sasaki and further in view of Lutjens be withdrawn.

In view of the foregoing amendments and discussion,
the application is believed to be in allowable form.
Accordingly, favorable reconsideration and allowance of the
claims are most respectfully requested.

Respectfully submitted,

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Name



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MAY 2, 2006

Date